Course Unit	Renewable Sources of Energy		Field of study	Physics
Master in	Renewable Energy and Energetic Efficiency		School	School of Technology and Management
Academic Year	2023/2024	Year of study	1	Level	2-1	ECTS credits	6.0
Type	Semestral	Semester	1	Code	6793-475-1102-00-23

Workload (hours)	162	Contact hours	T	30	TP	15	PL	15	TC	-	S	-	E	-	OT	-	O	-

T - Lectures; TP - Lectures and problem-solving; PL - Problem-solving, project or laboratory; TC - Fieldwork; S - Seminar; E - Placement; OT - Tutorial; O - Other

Name(s) of lecturer(s)	Tomás de Aquino Freitas Rosa Figueiredo

Learning outcomes and competences

At the end of the course unit the learner is expected to be able to:
1. Quantify and qualify endogenous resources.
2. Select technical approaches for recognizing and exploring, in an integrated perspective, the endogenous resources.
3. Communicate the evaluation results to the specialists and policy makers.

Prerequisites

Before the course unit the learner is expected to be able to:
Show basics of Maths and Physics at a graduation in science or engineering level

Course contents

Sources of energy (introduction). I Atmosphere resources (braod approach): atmosphere; meteorological data; radiation (radiation basics; solar and terrestrial radiation; radiation balance; radiation and insolation; radiation measurement). II Surface water resources: river flow, hydrological data; water as a resource; water resources and hydropower production (basics on micro-plant design).

Course contents (extended version)

1. Atmosphere Resources: background topics
   - The atmosphere: structure, composition, temperature and pressure distribution
   - Troposphere, Weather, Climate: elements, factors, grographic distribution
   - Meteorological data: from sensor to meteorological network, data quality, treatment and sources
2. Solar Radiation
   - Radiation laws; Quantities of radiation field; geographic distribution; solar constant
   - Radiation in the earth's atmosphere; Propagation of solar radiation; Radiation balance.
   - Radiation measurement; Radiation sensors; Shortwave and longwave measurements.
3. Water Resources superficiais Background topics
   - Watershed, water cycle, water balance: concepts and importance in Hydrology
   - Stream flow: generation, time and space distribution, extreme events
   - Stream flow data: measuring methods and devices, gauge network; data quality, treatment and sources
4. Water as a resource
   - Water use: classification, importance; consumptive use, requirements and reuse; water shortage
5. Water resources and hydropower
   - Hydropower plants (dams and runoff river): technical and environmental contrasts and similarities
   - Introdution to procedures for locating and designing mini hydropower plants: river hydraulics
   - Mini hydropower plants: catchment hydrology, power generation potential, hydraulic stuctures

Recommended reading

1. Castro, R. 2011. Uma Introdução às Energias Renováveis. IST Press, Lisboa. 490 pp
2. Foster, R. ; Ghassemi, M. & Cota, A. 2010. Solar Energy: Renewable Energy and the Environment. CRC Press, Ney York. 352 pp
3. Lencastre, A. & Franco, F. M. 2006. Lições de Hidrologia, 3ª ed, reimp. Universidade Nova de Lisboa - Fundação, Monte da Caparica.
4. Mays, L. W. 2001. Water Resources Engineering. Wiley, New York.
5. Monteith, J. L. & Unsworth, M. H. 1990. Principles of Environmental Physics. Edward Arnold, London. 291 pp.

Teaching and learning methods

Lectures: oral presentation. Lab sessions: resolution of exercises and written reports for the different exercises. Self study.

Assessment methods

1. Alternative 1 - (Regular, Student Worker) (Final, Supplementary, Special)
   - Practical Work - 80% (Tasks developed in each block of the programme, weighted according to block extent.)
   - Intermediate Written Test - 20% (Complementary assessment, compulsory for students not achieving positive results in Practicals.)
2. Alternative 2 - (Regular, Student Worker) (Final, Supplementary, Special)
   - Final Written Exam - 100% (For students not selecting/fulfiling requirements of/achieving positive mark in Alternative 1.)

Language of instruction

Portuguese, with additional English support for foreign students.

Electronic validation

Tomás de Aquino Freitas Rosa Figueiredo	Luís Manuel Frolen Ribeiro	José Carlos Rufino Amaro
29-09-2023	01-10-2023	07-10-2023